Appendix B: Economic Modeling Results

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Appendix B: Economic Modeling Results

Introduction

This appendix presents data from the economic modeling performed for WCI, including the model inputs and outputs for the cases examined. The focus here is on the data and assumptions used as model inputs and the model outputs. The main body of the Background Document discusses the policy implications of the model results.

This appendix is organized as follows:

- Cases Analyzed: describes the cases presented in this appendix.
- ENERGY 2020: provides a brief technical discussion of the model used.
- Assumptions: lists the primary assumptions used in the model.
- Outputs: defines the model outputs that are presented for the cases.
- Summary Results: provides a brief table of key model outputs.
- Reference Case: presents the results of the Reference Case.
- Cap-and-Trade Policy Cases: presents the results of the cap-and-trade policy cases.
- Sensitivity Cases: presents the results of three sensitivity cases.

As discussed below, additional detail on the ENERGY 2020 model and the model inputs and assumptions used in this analysis are presented in the *Assumptions Book for ENERGY 2020* posted on the WCI website.[1]

Cases Analyzed

This appendix presents three groups of cases. The first group is the Reference Case which reflects expectations in the absence of the WCI policies to reduce greenhouse gas emissions.

The second group is the Cap-and-Trade Policy Cases. These cases examine the primary alternatives for the cap-and-trade program, including whether to allow the use of offsets and whether to have a narrow or broad scope. The narrow scope includes stationary sources (including process emissions) and the electric sector. The broad scope also includes transportation fuels and residential/commercial fuels. The cases presented are:

- broad scope without offsets;
- broad scope with offsets; and
- narrow scope with offsets.

For all three Cap-and-Trade Policy cases, complementary policies are included along with the cap-and-trade program, including clean car standards, programs to reduce vehicle miles traveled, and energy efficiency programs. These complementary policies are defined below.

The third group of cases is the Sensitivity Cases. The purpose of the sensitivity cases is to assess the impacts of various assumptions and inputs on the model results. These assumptions can affect both the Reference Case and the Policy Cases. While a large number of

[1] The WCI website is: www.westernclimateinitiative.org.

assumptions and sensitivities are of interest, this analysis focuses on three sensitivities that were identified as most important by WCI partner jurisdictions and stakeholders.

- High Energy Prices and High Generation Costs: This sensitivity includes both higher energy prices and higher power generation costs as a set of conditions that could occur together in the future. This sensitivity was performed for both the Reference Case and the Policy Case with the broad scope and offsets.
- Low Energy Prices: This sensitivity uses energy prices that are lower than those used in the Reference Case. This sensitivity was performed for both the Reference Case and the Policy Case with the broad scope and offsets.
- High Natural Gas Prices: This sensitivity was designed to examine the impact of higher natural gas prices that may be induced by policies that are undertaken to reduce greenhouse gas emissions. Consequently, this sensitivity was applied to the Policy Case with broad scope and offsets. The results of this Policy Case are compared to the Reference Case with the standard natural gas price assumptions because the presumption is that policies are inducing the natural gas prices to increase.

Additional sensitivity analyses are warranted, and many important and worthwhile issues were identified by stakeholders during the conference calls and workshops that covered this work. However, due to time and resource constraints, additional sensitivities are not included at this time. Future work is anticipated that will enable additional sensitivity analyses to be performed.

ENERGY 2020

ENERGY 2020 was used to perform this analysis. A description of ENERGY 2020 is in the *Assumptions Book for Energy 2020* posted on the WCI website.[2] Additional documentation is available on the California Air Resources Board (ARB) website.[3] The following is a brief summary.

ENERGY 2020 is an integrated multi-region energy model that provides all-fuel demand and supply sector simulations. ENERGY 2020 can be linked to a detailed macroeconomic model to determine the economic impacts of energy/environmental policy and the energy and environmental impacts of national economic policy. However, the macroeconomic analysis was not performed for this study.

The model simulates demand by three residential categories (single family, multi-family, and agriculture/rural), over 40 NAICS commercial and industrial categories,[4] and three transportation services (passenger, freight, and off-road). There are approximately six end-uses per category and six technology/mode families per end-use.[5] The technology families

[2] The WCI website is: www.westernclimateinitiative.org.

[3] The posting on the ARB website is at: http://www.arb.ca.gov/cc/scopingplan/economics-sp/models/models.htm.

[4] NAICS is the North America Industrial Classification System which was developed jointly by the U.S., Canada, and Mexico to provide new comparability in statistics about business activity across North America.

[5] End-uses include Process Heat, Space Heating, Water Heating, Other Substitutable, Refrigeration, Lighting, Air Conditioning, Motors, and Other Non-Substitutable (Miscellaneous). Detailed modes include: small auto, large

correspond to six fuels groups (oil, gas, coal, electric, solar and biomass) and 30 detailed fuel products. The transportation sector contains 45 modes including various type of automobile, truck, off-road, bus, train, plane, marine and alternative-fuel vehicles. More end-uses, technologies, and modes can be added as data allow. For all end-uses and fuels, the model is parameterized based on historical, locale-specific data. The load duration curves for electricity demand are dynamically built up from the individual end-uses to capture changing conditions under consumer choice and combined gas/electric programs.

Each energy demand sector includes cogeneration, self-generation, and distributed generation simulation, including mobile-generation, micro-turbines, and fuel-cells. Fuel-switching responses are rigorously determined. The technology families (which can be split, as an option, to portray specific technology dynamics) are aggregates that, within the model, change building shell, economic-process and device efficiency and capital costs as price or other information that the decision makers see, change. ENERGY 2020 utilizes the historical and forecast data developed for each technology family to parameterize and disaggregate the model.

The supply portion of the model includes endogenous detailed electric supply simulation of capacity expansion/construction, rates/prices, load shape variation due to weather, and changes in regulation.[6] The model dispatches plants according to the specified rules whether they are optimal or heuristic and simulates transmission constraints when determining dispatch. A dispatch routine selects critical hours along seasonal load duration curves as a way to determine system generation. Peak and base hydro usage is explicitly modeled to capture hydro-plant impacts on the electric system.

ENERGY 2020 supply sectors include electricity, oil, natural gas, refined petroleum products, ethanol, land-fill gas, and coal supply. Energy used in primary production and emissions associated with primary production and its distribution is included in the model. The supply sectors included in a particular implementation of ENERGY 2020 will depend on the characteristics of the area being simulated and the problem being addressed. If the full supply sector is not needed, then a simplified simulation determines delivered-product prices.

ENERGY 2020 includes pollution accounting for both combustion (by fuel, end-use, and sector) and non-combustion, and non-energy (by economic activity) for SO_2, NO_2, N_2O, CO, CO_2, CH_4, PMT, $PM_{2.5}$, PM_5, PM_{10}, VOC, CF_4, C_2F_6, SF_6, and HFC at the state and provincial level by economic sector.

Assumptions

This section presents an overview of the major assumptions used in the modeling analysis. The *Assumptions Book for ENERGY 2020* presents a detailed list of the model inputs, including links to the data sources used to assemble the input data.

auto, light truck, medium-weight truck, heavy-weight truck, bus, freight train, commuter train, airplane, and marine. Each mode type can be characterized by gasoline, diesel, electric, ethanol, NG, propane, fuel-cell, or hybrid vehicles.

[6] ENERGY 2020 includes a complete, but aggregate representation of the electric transmission system.

- Geographic Coverage: This phase of the analysis covers the area of the Western Electricity Coordinating Council (WECC), which includes eight WCI partners: British Columbia, Washington, Oregon, California, Arizona, New Mexico, Utah, and Montana. By covering the entire WECC, the impacts of the WCI programs and policies on electricity generation in the non-WCI WECC states and provinces can be examined. Future analyses are planned that will incorporate the WCI partners that are not in the WECC, including Manitoba, Ontario, and Quebec.
- Sectors and Sources: This phase of the analysis includes energy use in all sectors, as well as most industrial process emissions. Landfill methane emissions and non-energy agriculture emissions are included in the total emissions estimates, but emission reductions are not estimated for these sources.[7] The analysis is based on gross emissions, so that forestry emissions and sinks are excluded.
- WCI Population and GDP Forecast: The model is driven by forecasts provided as input that include population growth and economic growth by detailed sector. Table B-1 shows the population growth forecast and Table B-2 shows the economic growth forecast.

Table B-1: Population Forecast for Eight WCI Partners, Selected Years (Millions)

Jurisdiction	2006	2010	2015	2020	Annual Growth
Arizona	6.2	7.0	7.9	8.8	2.5%
British Columbia	4.3	4.5	4.7	4.9	0.9%
California	37.4	39.1	41.5	44.1	1.2%
Montana	0.9	1.0	1.1	1.2	1.6%
New Mexico	2.0	2.2	2.3	2.5	1.8%
Oregon	3.7	3.9	4.1	4.3	1.1%
Utah	2.6	2.7	3.0	3.2	1.6%
Washington	6.4	6.8	7.3	7.7	1.4%
WCI	**63.5**	**67.2**	**71.9**	**76.7**	**1.4%**
Source: Assumptions Book for ENERGY 2020					

[7] Examples of non-energy agriculture emissions are methane emissions from livestock, carbon and N_2O emissions from agricultural soils, and methane emissions from livestock manure management.

Table B-2: Regional Gross Product Forecast for Eight WCI Partners, Selected Years (Billions of 2007 US dollars)

Jurisdiction	2006	2010	2015	2020	Annual Growth
Arizona	237	271	322	363	3.1%
British Columbia	266	294	326	358	2.1%
California	1,800	2,066	2,458	2,782	3.2%
Montana	33	37	42	47	2.5%
New Mexico	77	87	103	117	3.0%
Oregon	159	186	227	259	3.6%
Utah	98	111	129	146	2.9%
Washington	302	345	410	462	3.1%
WCI	**2,972**	**3,396**	**4,018**	**4,534**	**3.1%**
Source: Assumptions Book for ENERGY 2020					

- Emission Reduction Options: The model simulates decisions by energy users for each end use, including: fuel choice; investment in end use efficiency (e.g., by purchasing devices that are more efficient than the minimum required by standards); and end use utilization (how much the device is used). End-use specific choices are simulated as needed, such as mode choice for freight movement and passenger transportation. Choices are simulated based on costs (increased capital costs versus the value of fuel saved) as well as non-price attributes (convenience, acceptance of the technology). Past purchasing behavior is used to calibrate the non-price choice parameters for each end use.
- Energy Independence and Security Act of 2007 (EISA): The Reference Case, Policy Cases, and Sensitivity Cases include the requirements in the EISA, including the CAFÉ standards, appliance and lighting energy efficiency standards, and the renewable fuels standard (RFS). These requirements are assumed to be implemented fully in the WCI partner jurisdictions in the United States. For British Columbia and other Canadian provinces, lighting, equipment and appliance standards as set out by the Canadian Standards Association[8] as well as federal "ecoENERGY" Renewable Fuels Strategy[9] are incorporated.
- Renewable Portfolio Standards: All cases incorporate the individual Partner's already-adopted Renewable Portfolio Standards (RPS). See Appendix I of the *Assumptions Book for ENERGY 2020* for details.

[8] http://www.oee.nrcan.gc.ca/regulations/home_page.cfm

[9] This strategy requires 5% average renewable content based on the gasoline pool that is produced or imported, starting in 2010, and 2% average renewable content in diesel fuel and heating oil (distillate) by 2012. The Canada Gazette indicates that the 2% renewable content in diesel fuel and heating oil is equivalent to 5% renewable content in on-road diesel use. (See http://canadagazette.gc.ca/partI/2006/20061230/html/notice-e.html#i3)

- WCI Fuel Prices: The model is also driven by forecasts of fuel prices (oil, coal, natural gas). The model calculates electricity prices internally. Table B-3 shows the fuel price forecast used in the Reference Case. This forecast is taken from the Energy Information Agency's Annual Energy Outlook 2008 high price series. State- and province-specific prices are derived in the model from the prices shown in this table.

Table B-3: Fuel Price Forecast

	2006	2010	2015	2020
World Oil Price (2007 US$/barrel)	64.32	76.22	86.92	97.90
Natural Gas Wellhead Price (2007 US$/mmBtu)	6.93	7.50	7.13	7.29
Coal Prices (2007 US$/ton)	25.33	26.91	24.78	24.29
Source: EIA Annual Energy Outlook 2008 high price series.				

- First Jurisdictional Deliverer: All cases incorporate a proxy to represent First Jurisdictional Deliverer. Consequently, emissions from electricity imported into the WCI partner jurisdictions from outside the WCI partner jurisdictions are included in the analysis.
- Allowance Banking: The model enables allowances to be banked when allowance prices are low, and for allowances to be used from the bank when allowance prices are high. Attachment 1 discusses the parameters used to model allowance banking.
- Coal Plants: The cases allow no new coal plants to be built by 2020 in the WECC beyond those already planned and committed. See Appendix F of the *Assumptions Book for ENERGY 2020* for the list of coal plants that are assumed to be planned and committed.
- Nuclear Plants: The cases assume no new nuclear plants to be built by 2020 in the WECC.
- Carbon capture and storage: Carbon capture and storage is assumed not feasible for electric power generation through 2020.
- Hydropower: The cases assume no new hydropower capacity built in the WECC by 2020.
- Plug-in hybrids: The cases assume that plug-in hybrid and electric vehicles are not available in significant numbers through 2020.
- Electrical Generation Costs: The modeling effort relies on estimates of power generation capital costs, operating costs, and heat rates developed for a recent study for the California Public utilities Commission (see Table B-4).
- Macroeconomic estimates: This phase of the analysis does not include macroeconomic analysis.

Table B-4: Summary of Power Generation Cost Inputs

Technology	Total Capital Costs $/kW	Fixed O&M ($/kW-yr)	Variable O&M ($/MWh)	Capacity Factor	Nominal Heat Rate
Biogas	$2,623	107.5	0.01	85%	11,566
Biomass	$3,836	50.18	2.96	85%	15,509
Geothermal	$3,575	154.92	-	90%	-
Hydro - Small	$2,530	13.14	3.3	50%	-
Solar - Thermal	$2,840	49.63	-	40%	-
Wind	$1,983	28.51	-	37%	-
Coal ST	$2,671	25.91	4.32	85%	8,844
Coal IGCC	$3,087	36.36	2.75	85%	8,309
Coal IGCC with CCS	$5,127	42.82	4.18	85%	9,713
Gas CCCT	$878	11.04	2.4	90%	6,917
Gas CT	$794	11.4	3.36	5%	10,807
Hydro - Large	$2,530	13.14	3.3	50%	-
Nuclear	$4,999	63.88	0.47	85%	10,400
<5MW CHP	$1,952	11.04	2.4	40.5%	9,700
>5MW CHP	$1,259	11.04	2.4	85%	9,220
Cost Basis Year = 2005. All estimates are 2008 U.S. dollars. Source: E3 GHG Calculator v2b, tab "Gen Cost". Available at: http://www.ethree.com/GHG/GHG%20Calculator%20v2b.zip					

Outputs

The model results include estimates of energy use, GHG emissions, electricity generation, fuel prices, and costs. The following are brief explanations of the model results that are shown for the cases analyzed.

- Greenhouse Gas (GHG) Emissions: GHG emissions are presented in millions of metric tons of carbon dioxide equivalent ($MMTCO_2e$). Emissions for the eight WCI partner jurisdictions included in the analysis are presented by major sector.
- Compliance Summary: The Compliance Summary shows how GHG emissions are reduced to achieve the WCI partners' regional emissions goal of a 15% reduction from 2005 levels by 2020. The Compliance Summary shows a Compliance Total, which is the calculated emissions minus offsets used and adjusted for any allowances that are banked or that are used from the bank. The running total of emission allowances banked is also reported. The Compliance Total also considers changes in emissions in the non-WCI WECC power sector. The WCI cap-and-trade policies and complementary policies will affect GHG emissions from power generated in the non-WCI WECC states and provinces.

The change in these emissions are also included in the Compliance Total. To make this calculation, emissions associated with power imported into the WCI jurisdictions are estimated at 70 million tons per year. This estimate is preliminary, and is based on an assessment of recent power flows and emissions factors. Given the uncertainty in the estimate of these emissions, as well as the imperfect manner in which the First Jurisdictional Deliverer (FJD) policy is represented in the model, the reduction in emissions from the non-WCI WECC power sector counted toward the Compliance Total is limited to no more than 45 million tons in any year. Using this limit, the potential emission reduction from the non-WCI WECC power sector may be underestimated, thereby making the model evaluate a more stringent program than may be required in some cases. The Compliance Total is compared to 2006 emissions calculated in the model to estimate the emission reduction. In all the cases presented below, the compliance total shows approximately a 15% reduction in total economy wide emissions in 2020 relative to 2006. As discussed above, the estimates include only the eight WCI partner jurisdictions in the WECC.

- Total Energy Use: Total energy use is reported by fuel type and by major sector in units of TBtu/year.
- Electric Sector: Outputs for the electric sector include:
    - Generation Capacity in units of megaWatts (MW) by generation type. Note that estimated generation capacity grows due to capacity additions, but capacity retirement is not calculated. Consequently, generation capacity does not decline in the model outputs.
    - Generation Output in units of gigaWatt-hours per year (GWh/year) by generation type. The generation output is for the eight WCI partner jurisdictions in the WECC.
    - Electricity Sales in units of GWh/year, including electricity imports into the eight WCI partner jurisdictions in the WECC.
- Transportation Sector: Outputs for the transportation sector include vehicle miles traveled for passenger and freight vehicles, as well as miles traveled per passenger. The fleet average efficiency is reported for four vehicle types in miles per gallon.
- Fuel Prices: Fuel prices are reported for electricity, natural gas, coal, fuel oil, LPG, gasoline, and diesel in 2007 dollars per million Btu (2007 $/mmBtu). The prices include the forecasted energy prices (presented in Table B-3 above for the reference case and other tables below for the sensitivity cases) as well as the costs of delivering the fuels to market. The prices reported for the cap-and-trade policy cases also include the calculated allowance price, reflecting the appropriate carbon content of the fuel.
- Costs and Savings: Costs and savings are reported in millions of 2007 dollars per year ($M/Yr). Fuel Expenditures are reported by major sector, showing changes in expenditures from the Reference Case. These estimates of fuels expenditures do not include the value of the calculated allowance price, so a separate table of total allowance value is presented (equal to emissions times the allowance price). The allowance values reported by sector do not consider that the full allowance value may not be passed

through to consumers. Consequently, the allowance value by sector is reported as "potential" allowance value, recognizing that a portion of the allowance value may be borne by producers and not passed through to consumers. Total Costs are also reported by major sector, which are the sum of changes in fuel expenditures and changes in investment costs. Investment costs increase as more efficient devices, buildings, and processes are purchased in response to the limit on GHG emissions. The investment costs are annualized using a 5% real discount rate over the life of the equipment. The annualize costs are counted each year over the life of the equipment. The estimates of Total Costs include both the change in fuel expenditures and the change in investment costs. As shown in the tables below, the fuel expenditure savings typically offset most or all of the increased investment costs.

Results are shown only for the total of the eight WCI partners included in the analysis. State and province specific results are not included.

Reference Case

This section presents the results of the Reference Case. This case represents the future through 2020 in the absence of the WCI cap-and-trade program and related complementary GHG emission reduction policies. Table B-5 through Table B-10 show model outputs for:

- GHG emissions;
- energy use;
- electric sector results;
- transport sector results;
- fuel prices; and
- fuel expenditures.

Each table shows total results for the eight WCI Partners in the WECC. The three Canadian provinces not included in this analysis (Manitoba, Quebec, and Ontario) will be included in future modeling efforts.

Each table shows results for 2006 (the first year simulated by ENERGY 2020), 2010, 2015, and 2020. The growth rate reported for 2006-2020 is the average annual rate of exponential growth between the 2006 level and the 2020 level.

Table B-5: Reference Case Greenhouse Gas Emissions: Eight WCI Partners

GHG Emissions *(MMTCO2E)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	49.7	53.7	58.4	63.1	1.7%
Commercial	29.3	30.5	30.7	31.8	0.6%
Energy Intensive Industry	176.8	174.5	181.5	191.0	0.6%
Other Industry	29.8	30.3	30.5	31.0	0.3%
Passenger Transport	290.8	299.4	303.9	294.0	0.1%
Freight Transport	93.0	89.6	89.9	91.7	-0.1%
Power Sector	176.6	166.8	160.0	176.9	0.0%
Waste & Wastewater	25.6	29.1	34.2	38.4	2.9%
Agriculture (non-energy)	59.9	62.1	67.5	74.9	1.6%
Total	**931.6**	**936.1**	**956.6**	**992.8**	**0.5%**

Table B-6: Reference Case Energy Use: Eight WCI Partners

Total Energy Use *(TBtu/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Aviation Fuel	609	637	683	725	1.3%
Biomass	443	429	453	493	0.8%
Coal	1,185	1,215	1,204	1,259	0.4%
Diesel	1,091	1,051	1,032	1,025	-0.4%
Ethanol	85	173	335	480	13.2%
Landfill Gas	29	29	29	29	0.2%
LPG	231	240	256	282	1.4%
Gasoline	3,303	3,313	3,256	3,053	-0.6%
Natural Gas	3,947	3,779	3,733	4,018	0.1%
Nuclear	658	658	658	658	0.0%
Oil, Unspecified	695	688	692	714	0.2%
Other	2,902	2,949	3,092	3,349	1.0%
Total	**15,178**	**15,161**	**15,422**	**16,086**	**0.4%**

Total Energy Use *(TBtu/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	1,638	1,772	1,938	2,119	1.9%
Commercial	1,357	1,388	1,425	1,521	0.8%
Energy Intensive Industry	2,508	2,383	2,324	2,332	-0.5%
Other Industry	1,015	1,033	1,064	1,107	0.6%
Agriculture	140	127	114	104	-2.1%
Passenger Transportation	3,998	4,131	4,252	4,201	0.4%
Freight Transportation	1,219	1,183	1,208	1,251	0.2%
Waste & Wastewater	-	-	-	-	#N/A
Power Sector	3,302	3,143	3,097	3,450	0.3%
Total	**15,178**	**15,161**	**15,422**	**16,086**	**0.4%**

Table B-7: Reference Case Electric Sector Results: Eight WCI Partners

Generation Capacity *(MW)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Gas/Oil	62,973	72,139	78,999	88,519	2.5%
Coal	14,972	15,372	15,372	15,372	0.2%
Nuclear	9,330	9,330	9,330	9,330	0.0%
Hydro	61,721	63,374	63,428	63,508	0.2%
Landfill Gas/EFW	338	347	347	347	0.2%
Wind	4,083	6,827	18,575	24,513	13.7%
Other	4,358	4,537	5,572	6,582	3.0%
Total	**157,776**	**171,925**	**191,623**	**208,172**	**2.0%**
Generation Output *(GWh/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Gas/Oil	143,907	130,579	128,042	164,782	1.0%
Coal	99,280	100,482	98,019	101,454	0.2%
Nuclear	65,072	65,072	65,072	65,072	0.0%
Hydro	256,243	267,713	268,095	268,661	0.3%
Landfill Gas/EFW	2,036	2,088	2,088	2,088	0.2%
Wind	8,733	16,245	48,811	65,273	15.5%
Other	23,554	24,607	30,770	36,219	3.1%
Total	**598,824**	**606,784**	**640,897**	**703,548**	**1.2%**

Sales (GWh/year)	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	202,826	218,623	240,918	267,908	2.0%
Commercial	231,140	234,126	245,573	270,164	1.1%
Industrial	163,747	161,434	167,796	187,146	1.0%
Transportation	4,864	6,728	7,908	8,461	4.0%
Street Lights/Misc.	16,447	16,447	16,447	16,447	0.0%
Resale	-	-	-	-	#N/A
Total Sales	**619,023**	**637,357**	**678,642**	**750,126**	**1.4%**

Table B-8: Reference Case Transportation Sector Results: Eight WCI Partners

Distance Travelled (millions of vehicle miles travelled)					
	2006	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Passenger	556,055	589,783	635,948	678,750	1.4%
Freight	72,562	73,248	77,423	82,189	0.9%
Passenger: Miles/person	8,755	8,781	8,847	8,844	0.1%
Vehicle Efficiency (miles/gallon)					
	2006	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Light Gas Vehicles	23.2	24.1	25.5	28.5	1.5%
Medium Gas Vehicles	23.2	24.1	25.5	28.4	1.5%
Heavy Gas Vehicles	16.9	17.3	18.5	20.4	1.4%
Heavy Diesel Vehicles	16.9	17.3	18.4	20.3	1.3%
Vehicle efficiency represents a fleet-wide average, not the average for new vehicles.					

Table B-9: Reference Case Fuel Prices: Eight WCI Partners

Prices (2007 $/mmBtu)	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential					
Res Electricity Prices	29.4	30.9	29.8	30.1	0.2%
Res Natural Gas Prices	11.5	13.5	13.9	14.5	1.7%
Res Oil Prices	21.0	23.3	24.0	25.5	1.4%
Res LPG Prices	22.7	24.2	21.7	21.6	-0.3%
Commercial					
Com Electricity Prices	26.4	27.8	26.7	27.3	0.2%
Com Natural Gas Prices	8.8	10.0	9.8	10.1	1.0%
Com Oil Prices	23.1	25.0	24.0	24.6	0.4%
Com LPG Prices	22.5	24.3	21.7	21.4	-0.4%
Industrial					
Ind Electricity Prices	16.3	17.1	15.5	15.4	-0.4%
Ind Natural Gas Prices	6.7	7.3	6.4	6.3	-0.5%
Ind Coal Prices	2.2	2.2	2.1	2.1	-0.1%
Ind Oil Prices	16.4	18.4	19.2	20.7	1.7%
Ind LPG Prices	23.9	25.5	23.1	23.1	-0.2%
Transportation					
Gasoline Prices	21.9	24.1	26.0	28.0	1.8%
Diesel Prices	21.8	24.0	25.8	27.7	1.7%

Table B-10: Reference Case Fuel Expenditures: Eight WCI Partners

Annual Fuel Expenditures (Million$/Yr)					
Sector	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	31,763	37,464	38,000	39,874	1.6%
Commercial	28,452	31,263	28,473	28,752	0.1%
Energy Intensive Industry	28,969	31,127	28,694	29,058	0.0%
Other Industry	14,567	16,483	16,156	16,982	1.1%
Passenger Transportation	82,031	91,324	93,971	96,252	1.1%
Freight Transportation	28,315	30,055	32,178	35,156	1.6%
Agriculture	3,140	3,140	2,624	2,470	-1.7%
Total	**217,237**	**240,856**	**240,095**	**248,544**	**1.0%**

Cap-and-Trade Policy Cases

This section presents the results of three Cap-and-Trade Policy Cases:

- Broad Scope, with complementary policies and without offsets
- Broad Scope, with complementary policies and with offsets
- Narrow Scope, with complementary policies and with offsets

The narrow scope includes of the following:

- Electricity generation, including emissions from electricity imported into WCI jurisdictions from non-WCI jurisdictions
- Combustion at industrial and commercial facilities
- Industrial process emission sources, including oil and gas process emissions

The broad scope includes the emissions in the narrow scope plus the following:[10]

- Residential, commercial, and industrial fuel combustion at facilities with emissions below the WCI thresholds
- Transportation fuel combustion from gasoline and diesel

The banking of allowances is included in all three Policy Cases to simulate how allowances issued or auctioned in one year may be used in a later period. When allowance prices are low, allowances would likely be saved for use in a later year – which is referred to as being banked. When prices are high, allowances would be used from previous year, which is referred to as withdrawn from the bank. Attachment 1 explains how the model simulates banking and withdrawing of allowances.

Offsets are limited to 5% of the compliance obligation. The supply of offsets is modeled using an S-shaped curve that defines the portion of the offset limit that would be used as a function of allowance price. The analyses presented here limit the use of offsets to 5% of the annual compliance obligation, with an expected price of $20 per MTCO2e. Figure B-1 shows how the model simulates the use of offsets. At an allowance price of $20 per MTCO2e, approximately 58% of the offset limit is estimated to be used.

The Offsets Subcommittee is defining a process to develop offset supply curve data reflecting the availability and price of offsets under various offset policy assumptions. When available, those data would enable a more precise assessment to be conducted of the implications of policies that include offsets as a design feature.

The complementary policies have a substantial impact on the estimated emissions and costs. This analysis incorporates three broad sets of policies across all eight WCI partner jurisdictions in the analysis:

- Clean Car Standards, equivalent to California's Pavley I and II. These standards reduce emissions by about 30 MMTCO2E in 2020 compared to the Reference Case.

[10] For purposes of modeling the broad scope of the cap-and-trade program, the eight WCI partner jurisdictions included in the analysis are modeled with the broad scope starting in 2012. Note that British Columbia plans to use its carbon tax as an alternative policy for covering transportation fuels and residential/commercial fuels. This modeling effort, however, treats British Columbia the same as the other seven WCI partner jurisdictions included in the analysis.

- Programs that reduce total Vehicle Miles Traveled (VMT) by 2% from the forecast reference case by 2020. These programs reduce emissions by about 4 MMTCO2E when considered in addition to the Clean Car Standards.
- Aggressive energy efficiency programs that achieve a 1% reduction in the annual rate of electricity and natural gas demand growth. These programs reduce emissions by about 74 MMTCO2E in 2020 across all sectors.

We recognize that the WCI partner jurisdictions have climate action plans that reflect the specific opportunities and needs of the individual jurisdictions. In particular, they typically include policies that extend beyond the three included in this analysis. Based on the available time and resources for this study, as well as the focus on overall results for the WCI partner jurisdictions as a whole, the analysis is limited to reflecting these broad policies at this time.

By themselves the three complementary policies included in the analysis accomplish about 108 MMTCO2E of GHG reductions in 2020, which is about half of the reductions required from the Reference Case estimates in this analysis. Table B-11 shows the estimates for the transportation policies.

The complementary policies are modeled in conjunction with the cap-and-trade policies under the expectation that the cap-and-trade program can provide resources needed for supporting the VMT programs and the energy efficiency programs. In particular, the value of emission allowances (whether auctioned or provided for free) can be directed to support these programs.

Figure B-1: Assumed Offset Supply Curve

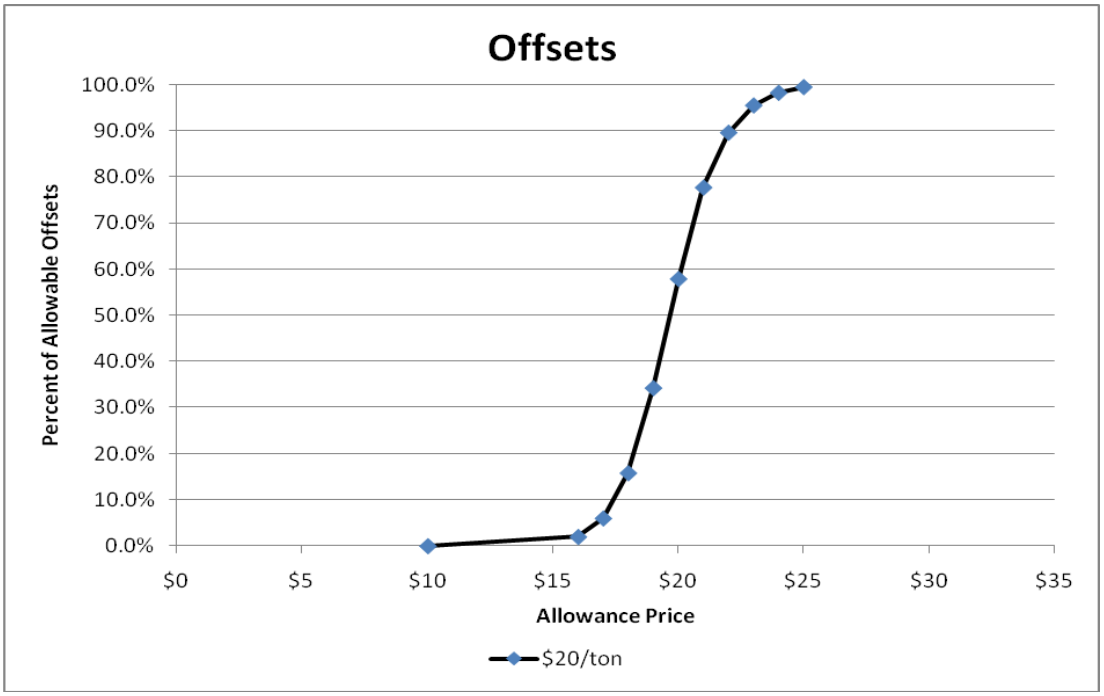


Table B-11: Impact of Transportation Complementary Policies in 2020 Compared to the Reference Case: Eight WCI Partners

	Clean Car Standards	Clean Car Standards and VMT Reduction
Change in GHG Emissions (million tons)	-30.1	-34.2
Change in Annual Vehicle Miles Traveled/Person	112	-65
Change in Annual Fuel Expenditures (million 2007$)	($11,943)	($13,549)
Change in Vehicle Capital Expenditures (million 2007$)	$10,325	($5,549)
Net Cost (Savings) (million 2007$)	($1,618)	($19,098)
Net cost does not include the cost of VMT Reduction programs.		

Table B-12 through Table B-19 show model outputs for these quantities:

- GHG emissions and compliance summary;
- energy use;
- electric sector results;
- transport sector results;
- fuel prices;
- fuel expenditures;
- potential allowance value; and
- costs.

Each table shows results for 2020 for eight WCI Partners, i.e., the seven states and British Columbia. As discussed above, the other three Canadian provinces will be included in future modeling efforts. For each policy case, the three columns indicate the Cap-and-Trade value for the quantity described in the left-most column, the difference between the Cap-and-Trade value and the Reference Case value, and the percentage difference between the two values.

Table B-16 shows fuel prices as a percent difference from Reference Case prices. Table B-19 shows the cost estimates, which only meaningful as incremental differences between the Cap-and-Trade value and the Reference Case value.

Table B-12: Cap-and-Trade Cases Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners

GHG Emissions in 2020 *(MMTCO2E)*	**Reference Case**	**Broad, Comp Policies No Offsets**			**Broad, Comp Policies With Offsets**			**Narrow, Comp Policies With Offsets**		
		Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff
Residential	63.1	55.0	-8.1	-12.8%	55.2	-7.9	-12.5%	55.9	-7.2	-11.4%
Commercial	31.8	26.2	-5.6	-17.5%	26.4	-5.4	-17.1%	27.0	-4.8	-15.0%
Energy Intensive Industry	191.0	174.5	-16.6	-8.7%	175.0	-16.0	-8.4%	172.6	-18.5	-9.7%
Other Industry	31.0	26.9	-4.2	-13.5%	27.0	-4.0	-12.9%	26.3	-4.8	-15.3%
Passenger Transport	294.0	258.7	-35.2	-12.0%	259.0	-34.9	-11.9%	259.9	-34.1	-11.6%
Freight Transport	91.7	89.9	-1.7	-1.9%	90.4	-1.3	-1.4%	91.7	0.0	0.0%
Power Sector	176.9	114.6	-62.2	-35.2%	131.5	-45.3	-25.6%	104.8	-72.1	-40.7%
Waste & Wastewater	38.4	38.4	0.0	0.0%	38.4	0.0	0.0%	38.4	0.0	0.0%
Agriculture (non-energy)	74.9	74.9	0.0	0.0%	74.9	0.0	0.0%	71.1	-3.7	-5.0%
WCI Sub-Total	**992.8**	**859.2**	**-133.6**	**-13.5%**	**877.9**	**-114.9**	**-11.6%**	**847.8**	**-145.0**	**-14.6%**
Non-WCI Power Sector	70.0	70.0			70.0			70.0		
Non-WCI Power Sector Reductions		-45.0			-37.0			-45.0		
Offsets		0.0			-31.8			-18.2		
Bank Flow		-31.1			-31.8			-0.2		
Compliance Total		**853.1**			**847.2**			**854.3**		
Percent of 2006 Emissions		85.2%			84.6%			85.3%		
Bank Inventory		72.6			74.4			0.5		
Allowance Price (2007 $/MT)		**$63**			**$24**			**$71**		
All emissions in millions of metric tons.										

Table B-13: Cap-and-Trade Cases Energy Use: Eight WCI Partners

	Reference Case	Broad, Comp Policies No Offsets			Broad, Comp Policies With Offsets			Narrow, Comp Policies With Offsets		
		Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff
Total Energy Use in 2020 *(TBtu/year)*										
Aviation Fuel	725	717.9	(7.4)	-1.0%	720	(5)	-0.7%	725	-	0.0%
Biomass	493	449	(44)	-8.9%	448	(45)	-9.1%	452	(41)	-8.3%
Coal	1,259	758	(502)	-39.8%	1,043	(217)	-17.2%	618	(642)	-50.9%
Diesel	1,025	995	(30)	-2.9%	1,001	(25)	-2.4%	1,014	(11)	-1.1%
Ethanol	480	421	(59)	-12.2%	420	(59)	-12.4%	419	(61)	-12.7%
Landfill Gas	29	29	(0)	0.0%	29	0	0.0%	29	(0)	0.0%
LPG	282	248	(33)	-11.8%	249	(32)	-11.5%	250	(32)	-11.3%
Gasoline	3,053	2,625	(429)	-14.0%	2,628	(426)	-13.9%	2,635	(418)	-13.7%
Natural Gas	4,018	3,245	(774)	-19.3%	3,075	(944)	-23.5%	3,296	(722)	-18.0%
Nuclear	658	658	-	0.0%	658	-	0.0%	658	-	0.0%
Oil, Unspecified	714	686	(27)	-3.8%	688	(26)	-3.6%	687	(27)	-3.8%
Other	3,349	2,956	(393)	-11.7%	2,952	(397)	-11.9%	2,934	(415)	-12.4%
Total	**16,086**	**13,788**	**(2,298)**	**-14.3%**	**13,911**	**(2,176)**	**-13.5%**	**13,718**	**(2,369)**	**-14.7%**
Total Energy Use in 2020 (Tbtu/year)										
Residential	2,119	1,853	(266)	-12.6%	1,856	(264)	-12.5%	1,863	(257)	-12.1%
Commercial	1,521	1,259	(262)	-17.2%	1,260	(261)	-17.2%	1,265	(256)	-16.8%
Energy Intensive Industry	2,332	2,029	(303)	-13.0%	2,035	(297)	-12.7%	2,005	(328)	-14.0%
Other Industry	1,107	1,001	(106)	-9.6%	1,003	(104)	-9.4%	991	(116)	-10.5%
Agriculture	104	93	(11)	-10.2%	94	(10)	-10.1%	92	(12)	-11.4%
Passenger Transportation	4,201	3,698	(503)	-12.0%	3,702	(499)	-11.9%	3,712	(489)	-11.6%
Freight Transportation	1,251	1,229	(22)	-1.8%	1,235	(16)	-1.3%	1,251	-	0.0%
Waste & Wastewater	-	-			-			-		
Power Sector	3,450	2,626	(824)	-23.9%	2,727	(724)	-21.0%	2,539	(912)	-26.4%
Total	**16,086**	**13,788**	**(2,298)**	**-14.3%**	**13,911**	**(2,176)**	**-13.5%**	**13,718**	**(2,369)**	**-14.7%**

Table B-14: Cap-and-Trade Cases Electric Sector Results: Eight WCI Partners

	Reference Case	Broad, Comp Policies No Offsets			Broad, Comp Policies With Offsets			Narrow, Comp Policies With Offsets		
		Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff
Generation Capacity in 2020 *(MW)*										
Gas/Oil	88,519	109,759	21,240	24.0%	109,919	21,400	24.2%	109,879	21,360	24.1%
Coal	15,372	15,372	-	0.0%	15,372	-	0.0%	15,372	-	0.0%
Nuclear	9,330	9,330	-	0.0%	9,330	-	0.0%	9,330	-	0.0%
Hydro	63,508	63,471	(37)	-0.1%	63,471	(37)	-0.1%	63,462	(46)	-0.1%
Landfill Gas/EFW	347	347	-	0.0%	347	-	0.0%	347	-	0.0%
Wind	24,513	22,943	(1,570)	-6.4%	22,945	(1,569)	-6.4%	22,721	(1,792)	-7.3%
Other	6,582	6,354	(228)	-3.5%	6,354	(228)	-3.5%	6,344	(238)	-3.6%
Total	**208,172**	**227,576**	**19,405**	**9.3%**	**227,738**	**19,566**	**9.4%**	**227,456**	**19,284**	**9.3%**
Generation Output 2020 (*GWh/year)*										
Gas/Oil	164,782	127,711	(37,072)	-22.5%	101,382	(63,400)	-38.5%	134,044	(30,738)	-18.7%
Coal	101,454	58,979	(42,474)	-41.9%	85,318	(16,136)	-15.9%	46,848	(54,606)	-53.8%
Nuclear	65,072	65,072	-	0.0%	65,072	-	0.0%	65,072	-	0.0%
Hydro	268,661	268,398	(263)	-0.1%	268,398	(263)	-0.1%	268,337	(324)	-0.1%
Landfill Gas/EFW	2,088	2,088	(0)	0.0%	2,088	0	0.0%	2,088	(0)	0.0%
Wind	65,273	60,920	(4,353)	-6.7%	60,925	(4,348)	-6.7%	60,305	(4,968)	-7.6%
Other	36,219	34,579	(1,640)	-4.5%	34,579	(1,640)	-4.5%	34,558	(1,661)	-4.6%
Total	**703,548**	**617,746**	**(85,803)**	**-12.2%**	**617,761**	**(85,788)**	**-12.2%**	**611,251**	**(92,297)**	**-13.1%**
Sales in 2020*(GWh/year)*										
Residential	267,908	232,745	(35,163)	-13.1%	232,447	(35,462)	-13.2%	230,725	(37,183)	-13.9%
Commercial	270,164	223,406	(46,758)	-17.3%	222,998	(47,166)	-17.5%	221,170	(48,994)	-18.1%
Industrial	187,146	162,812	(24,333)	-13.0%	162,071	(25,075)	-13.4%	162,118	(25,027)	-13.4%
Transportation	8,461	8,268	(193)	-2.3%	8,229	(232)	-2.7%	7,923	(538)	-6.4%
Street Lights/Misc.	16,447	16,447	-	0.0%	16,447	-	0.0%	16,447	-	0.0%
Total Sales	**750,126**	**643,678**	**(106,447)**	**-14.2%**	**642,191**	**(107,935)**	**-14.4%**	**638,383**	**(111,743)**	**-14.9%**

Table B-15: Cap-and-Trade Cases Transportation Sector Results: Eight WCI Partners

	Reference Case	Broad, Comp Policies No Offsets			Broad, Comp Policies With Offsets			Narrow, Comp Policies With Offsets		
		Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff
Distance Travelled in 2020 *(millions of vehicle miles travelled)*										
Passenger	678,750	672,238	(6,512)	-1.0%	672,665	(6,085)	-0.9%	673,720	(5,031)	-0.7%
Freight	82,189	81,516	(673)	-0.8%	81,715	(474)	-0.6%	82,189	-	0.0%
Passenger: Miles/person	8,844	8,759	(85)	-1.0%	8,765	(79)	-0.9%	8,778	(66)	-0.7%
Vehicle Efficiency in 2020 *(miles/gallon)*										
Light Gas Vehicles	28.5	33	4	15.3%	33	4	15.4%	33	4	15.3%
Medium Gas Vehicles	28.4	33	4	15.3%	33	4	15.3%	33	4	15.3%
Heavy Gas Vehicles	20.4	24	4	17.4%	24	4	17.5%	24	4	17.5%
Heavy Diesel Vehicles	20.3	24	4	17.5%	24	4	17.5%	24	4	17.5%
Vehicle efficiency represents a fleet-wide average, not the average for new vehicles.										

Table B-16: Cap-and-Trade Cases Fuel Price Results: Eight WCI Partners

Prices in 2020 (2007 $/mmBtu)	**Reference Case**	**Broad, Comp Policies No Offsets**	**Broad, Comp Policies With Offsets**	**Narrow, Comp Policies With Offsets**
	Price	Percent Diff	Percent Diff	Percent Diff
Residential				
Res Electricity Prices	30.1	-0.3%	1.0%	12.7%
Res Natural Gas Prices	14.5	31.4%	12.2%	1.0%
Res Oil Prices	25.5	20.4%	7.7%	-0.1%
Res LPG Prices	21.6	14.6%	5.6%	0.0%
Commercial				
Com Electricity Prices	27.3	-2.4%	-0.2%	14.3%
Com Natural Gas Prices	10.1	23.7%	7.9%	-1.0%
Com Oil Prices	24.6	4.9%	2.1%	0.4%
Com LPG Prices	21.4	9.2%	4.4%	1.3%
Industrial				
Ind Electricity Prices	15.4	4.7%	6.6%	35.6%
Ind Natural Gas Prices	6.3	19.2%	7.1%	20.2%
Ind Coal Prices	2.1	167.4%	64.3%	182.4%
Ind Oil Prices	20.7	17.2%	6.5%	19.4%
Ind LPG Prices	23.1	6.2%	2.9%	7.0%
Transportation				
Gasoline Prices	28.0	17.4%	6.6%	0.0%
Diesel Prices	27.7	16.8%	6.4%	0.0%

Table B-17: Cap-and-Trade Cases Fuel Expenditure Results: Eight WCI Partners

Annual Fuel Expenditures in 2020 (M$/Yr)	Reference Case	Broad, Comp Policies No Offsets			Broad, Comp Policies With Offsets			Narrow, Comp Policies With Offsets		
		Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff	Value	Diff from Reference	Percent Diff
Sector										
Residential	45,609	39,918	(5,691)	-12.5%	40,244	(5,365)	-11.8%	43,138	(2,471)	-5.4%
Commercial	35,373	28,861	(6,512)	-18.4%	29,356	(6,017)	-17.0%	32,098	(3,275)	-9.3%
Energy Intensive Industry	32,725	29,018	(3,707)	-11.3%	29,119	(3,606)	-11.0%	29,831	(2,894)	-8.8%
Other Industry	18,496	17,001	(1,495)	-8.1%	17,062	(1,434)	-7.8%	17,977	(519)	-2.8%
Passenger Transportation	110,035	96,146	(13,889)	-12.6%	96,251	(13,784)	-12.5%	96,577	(13,458)	-12.2%
Freight Transportation	35,567	34,932	(636)	-1.8%	35,111	(457)	-1.3%	35,568	0	0.0%
Agriculture	2,848	2,482	(366)	-12.8%	2,499	(349)	-12.2%	2,669	(178)	-6.3%
Total	**280,654**	**248,358**	**(32,296)**	**-11.5%**	**249,641**	**(31,012)**	**-11.0%**	**257,859**	**(22,794)**	**-8.1%**

Table B-18: Cap-and-Trade Program Potential Allowance Value: Eight WCI Partners

Allowance Value in 2020 (M$)	Broad, Comp Policies No Offsets	Broad, Comp Policies With Offsets	Narrow, Comp Policies With Offsets
	Diff from Reference	Diff from Reference	Diff from Reference
Sector			
Residential	$3,445	$1,321	$0
Commercial	$1,641	$631	$1,925
Energy Intensive Industry	$10,922	$4,188	$12,293
Other Industry	$1,681	$647	$1,873
Passenger Transportation	$16,197	$6,199	$0
Freight Transportation	$5,630	$2,164	$0
Agriculture	$0	$0	$0
Total	**39,516**	**15,150**	**16,092**
Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.			

Table B-19: Cap-and-Trade Cases Cost Results: Eight WCI Partners

Annualized Costs in 2020 (M$/Yr)	Broad, Comp Policies No Offsets	Broad, Comp Policies With Offsets	Narrow, Comp Policies With Offsets
	Diff from Reference	Diff from Reference	Diff from Reference
Sector			
Residential	(6,443)	(6,158)	(3,327)
Commercial	(7,845)	(7,369)	(4,760)
Energy Intensive Industry	10,935	10,908	12,674
Other Industry	1,979	1,996	3,250
Passenger Transportation	(20,988)	(20,511)	(19,005)
Freight Transportation	(722)	(522)	0
Agriculture	(442)	(425)	(254)
Total	**(23,525)**	**(22,080)**	**(11,422)**
These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.			

Sensitivity Cases

This section presents the results of three sensitivity cases. These cases consider alternatives to the energy prices and generation costs assumed in the Reference Case. The cases discussed here are:

- High Energy Prices and High Generation Costs
- Low Energy Price Case
- High Natural Gas Price Case

Other cases are also of interest, but time did not allow for development of input data for them to be modeled in a meaningful way.

For the first two of these sensitivity cases, it was necessary to produce a new Reference Case as well as a policy case. In these cases the policy is compared to its appropriate sensitivity Reference Case.

For all the sensitivity cases, the WCI policy case is for the broad scope with offsets. The sensitivities are variations of the assumptions embedded in the Reference Case, not variations of cap-and-trade policy design.

High Energy Prices and High Generation Costs

The purpose of this sensitivity is to examine the implications of energy prices being higher than assumed in the Reference Case. There has been considerable stakeholder comment that the energy prices in the Reference Case may be too low. Additionally, some stakeholders have commented that the power generation cost assumptions maybe too low, indicating that the recent increases in commodity prices have had an impact on these costs.

This sensitivity includes both increased energy prices and increased power generation costs as a set of conditions that could occur together in the future. The high energy cost case assumes that energy prices start at current 2008 prices and increase in real terms by 50% by 2020, as shown in Table B-20. The high power generation cost case assumes that capital and operation and maintenance (O&M) costs are 30% higher than in the Reference Case.

Table B-20: Fuel Price Forecast:
High Energy Prices and High Generation Costs Sensitivity Case

	2006	2010	2015	2020
World Oil Price (2007 US$/barrel)	64.21	120.37	143.52	166.67
Natural Gas Wellhead Price (2007 US$/mmBtu)	5.97	11.12	13.26	15.40
Coal Prices (2007 US$/ton)	28.98	41.47	48.52	55.90

Low Energy Price Case

The purpose of this sensitivity is to examine the implications of energy prices being lower than assumed in the Reference Case. While there has not been stakeholder comment suggesting that energy prices may be lower, it is prudent to examine the implications of

lower prices. The low energy price case uses the mid-price case from the Annual Energy Outlook 2008 (Table B-21).

Table B-21: Fuel Price Forecast: Low Energy Price Sensitivity Case

	2006	2010	2015	2020
World Oil Price (2007 US$/barrel)	$64.21	$71.60	$57.88	$57.74
Natural Gas Wellhead Price (2007 US$/mmBtu)	$5.97	$7.11	$6.09	$6.25
Coal Prices (2007 US$/ton)	$25.37	$26.66	$23.53	$22.33
Source: EIA Annual Energy Outlook 2008 mid-price series.				

High Natural Gas Price Case

The purpose of this sensitivity is to examine the implications of natural gas prices being higher than assumed in the Reference Case. There has been considerable stakeholder comment that efforts to reduce GHG emissions may increase the demand for natural gas. Consequently, the price of natural gas may increase as a result of the policies that are implemented to reduce emissions.

In the cases examined above, the demand for natural gas declines overall as a result of the complementary policies and the cap-and-trade program. Consequently, the policies examined in this analysis would not be expected to lead to an increase in natural gas prices. Nevertheless, this sensitivity was performed to examined the implications of higher natural gas prices.

To perform this sensitivity, the high natural gas price shown in Table B-20 was used with the cap-and-trade policy. The results were compared to the original Reference Case with the Reference Case natural gas prices. So, the natural gas prices are higher in the cap-and-trade case than in the Reference Case.

Results

Table B-22 through Table B-29 show model outputs for 2020: Each table shows results for eight WCI Partners, i.e., the seven states and British Columbia. The other three provinces will be included in future modeling efforts.

For each policy case, the three columns indicate the relevant Reference Case value (because each policy case has a different Reference Case), Cap-and-Trade value for the quantity described in the left-most column, and the difference between the Cap-and-Trade value and its Reference value.

Table B-26 shows fuel prices as a percent difference from Reference prices. Table B-29 shows the costs, which are only meaningful as incremental differences between the Cap-and-Trade value and the appropriate Reference Case.

Table B-22: Sensitivity Cases Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners

GHG Emissions in 2020 *(MMTCO2E)*	**Original Reference Case**	**High Energy Prices & Generation Costs**			**Low Energy Prices**			**High Natural Gas Prices**		
		Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff
Residential	63.1	58.5	52.2	-6.3	63.9	55.1	-8.7	63.1	51.9	-11.2
Commercial	31.8	28.0	23.9	-4.1	32.1	26.2	-5.9	31.8	23.7	-8.1
Energy Intensive Industry	191.0	182.4	170.0	-12.4	193.4	174.6	-18.8	191.0	174.5	-16.6
Other Industry	31.0	28.0	25.0	-3.0	31.9	27.0	-4.9	31.0	25.7	-5.4
Passenger Transport	294.0	276.0	244.1	-31.9	299.6	262.4	-37.2	294.0	259.1	-34.9
Freight Transport	91.7	79.0	78.5	-0.5	100.2	95.9	-4.3	91.7	90.7	-1.0
Power Sector	176.9	166.5	126.2	-40.3	177.1	102.4	-74.7	176.9	126.6	-50.2
Waste & Wastewater	38.4	38.4	38.4	0.0	38.4	38.4	0.0	38.4	38.4	0.0
Agriculture (non-energy)	74.9	74.9	74.9	0.0	74.9	74.9	0.0	74.9	74.9	0.0
WCI Sub-Total	**992.8**	**931.8**	**833.3**	**-98.6**	**1011.4**	**857.0**	**-154.5**	**992.8**	**865.4**	**-127.4**
Non-WCI Power Sector	70.0	70.0	70.0	-	70.0	70.0	-	70.0	70.0	-
Non-WCI Power Sector Reductions			(42.4)			(45.0)			(45.0)	
Offsets			(12.7)			(34.1)			(26.6)	
Bank Flow			-0.2			-0.1			-11.7	
Compliance Total			**847.9**			**847.8**			**852.1**	
Percent of 2006 Emissions			*84.7%*			*84.6%*			*85.1%*	
Bank Inventory			30.8			0.1			168.4	
Allowance Price (2007 $/MT)			**$18**			**$56**			**$20**	
All emissions in millions of metric tons.										

Table B-23: Sensitivity Cases Energy Use Results: Eight WCI Partners

	Original Reference Case	High Energy Prices & Generation Costs			Low Energy Prices			High Natural Gas Prices		
		Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff
Total Energy Use in 2020 (TBtu/year)										
Aviation Fuel	725	680	678	(2)	753	738	(15)	725	721	(4)
Biomass	493	528	469	(59)	495	448	(47)	493	456	(37)
Coal	1,259	1,223	1,055	(168)	1,252	609	(642)	1,259	1,100	(160)
Diesel	1,025	876	861	(15)	1,126	1,067	(59)	1,025	1,004	(21)
Ethanol	480	509	445	(64)	466	412	(55)	480	420	(60)
Landfill Gas	29	29	29	0	29	29	(0)	29	29	(0)
LPG	282	332	285	(47)	271	243	(28)	282	273	(9)
Gasoline	3,053	2,824	2,439	(385)	3,120	2,666	(454)	3,053	2,631	(423)
Natural Gas	4,018	3,478	2,687	(791)	4,065	3,252	(813)	4,018	2,641	(1,378)
Nuclear	658	658	658	-	658	658	-	658	658	-
Oil, Unspecified	714	681	662	(19)	757	714	(43)	714	706	(7)
Other	3,349	3,347	2,987	(360)	3,347	2,943	(404)	3,349	3,017	(332)
Total	**16,086**	**15,164**	**13,255**	**(1,909)**	**16,340**	**13,780**	**(2,560)**	**16,086**	**13,656**	**(2,431)**
Total Energy Use in 2020 (TBtu/year)										
Residential	2,119	2,028	1,802	(226)	2,135	1,854	(281)	2,119	1,803	(316)
Commercial	1,521	1,453	1,231	(222)	1,530	1,261	(269)	1,521	1,233	(288)
Energy Intensive Industry	2,332	2,205	1,963	(242)	2,361	2,029	(332)	2,332	2,004	(328)
Other Industry	1,107	1,050	968	(82)	1,118	1,000	(118)	1,107	976	(131)
Agriculture	104	95	88	(8)	108	95	(13)	104	91	(13)
Passenger Transportation	4,201	3,960	3,500	(460)	4,274	3,745	(530)	4,201	3,699	(502)
Freight Transportation	1,251	1,092	1,085	(6)	1,360	1,305	(55)	1,251	1,238	(13)
Waste & Wastewater	-	-	-	-	-	-	-	-	-	-
Power Sector	3,450	3,281	2,618	(664)	3,454	2,492	(962)	3,450	2,610	(840)
Total	**16,086**	**15,164**	**13,255**	**(1,909)**	**16,340**	**13,780**	**(2,560)**	**16,086**	**13,656**	**(2,431)**

Table B-24: Sensitivity Cases Electric Sector Results: Eight WCI Partners

	Original Reference Case	High Energy Prices & Generation Costs			Low Energy Prices			High Natural Gas Prices		
		Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff
Generation Capacity in 2020 *(MW)*										
Gas/Oil	88,519	89,519	106,599	17,080	86,239	108,759	22,520	88,519	136,359	47,840
Coal	15,372	15,372	15,372	-	15,372	15,372	-	15,372	15,372	-
Nuclear	9,330	9,330	9,330	-	9,330	9,330	-	9,330	9,330	-
Hydro	63,508	63,914	63,426	(488)	63,507	63,464	(43)	63,508	63,397	(111)
Landfill Gas/EFW	347	347	347	-	347	347	-	347	347	-
Wind	24,513	22,766	21,533	(1,233)	24,290	22,829	(1,461)	24,513	23,967	(546)
Other	6,582	6,695	6,330	(365)	6,646	6,384	(262)	6,582	6,343	(239)
Total	**208,172**	**207,943**	**222,938**	**14,995**	**205,731**	**226,485**	**20,754**	**208,172**	**255,115**	**46,943**
Generation Output 2020 *(GWh/year)*										
Gas/Oil	164,782	145,539	81,131	(64,407)	162,219	128,052	(34,167)	164,782	84,935	(79,847)
Coal	101,454	101,513	88,202	(13,312)	101,389	46,101	(55,288)	101,454	88,847	(12,606)
Nuclear	65,072	65,072	65,072	-	65,072	65,072	-	65,072	65,072	-
Hydro	268,661	271,519	268,082	(3,437)	268,649	268,349	(300)	268,661	267,877	(784)
Landfill Gas/EFW	2,088	2,088	2,088	0	2,088	2,088	(0)	2,088	2,088	(0)
Wind	65,273	60,428	57,011	(3,417)	64,654	60,603	(4,051)	65,273	63,758	(1,515)
Other	36,219	36,501	34,019	(2,482)	36,886	34,499	(2,387)	36,219	32,919	(3,299)
Total	**703,548**	**682,659**	**595,605**	**(87,055)**	**700,956**	**604,763**	**(96,193)**	**703,548**	**605,496**	**(98,052)**
Sales in 2020*(GWh/year)*										
Residential	267,908	267,531	233,815	(33,717)	267,625	232,186	(35,439)	267,908	235,623	(32,286)
Commercial	270,164	272,103	227,845	(44,257)	268,841	222,860	(45,980)	270,164	228,621	(41,542)
Industrial	187,146	186,028	163,446	(22,582)	185,238	160,256	(24,983)	187,146	164,351	(22,795)
Transportation	8,461	7,533	7,413	(120)	8,537	8,071	(465)	8,461	7,458	(1,003)
Street Lights/Misc.	16,447	16,447	16,447	-	16,447	16,447	-	16,447	16,447	-
Total Sales	**750,126**	**749,642**	**648,966**	**(100,676)**	**746,687**	**639,820**	**(106,867)**	**750,126**	**652,500**	**(97,625)**

Table B-25: Sensitivity Cases Transportation Sector Results: Eight WCI Partners

	Original Reference Case	High Energy Prices & Generation Costs			Low Energy Prices			High Natural Gas Prices		
		Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff
Distance Travelled in 2020 *(millions of vehicle miles travelled)*										
Passenger	678,750	663,044	659,404	(3,640)	686,691	677,633	(9,058)	678,750	672,895	(5,855)
Freight	82,189	77,505	77,301	(205)	85,286	83,768	(1,518)	82,189	81,805	(384)
Passenger: Miles/person	8,844	8,639	8,592	(47)	8,948	8,829	(118)	8,844	8,768	(76)
Vehicle Efficiency in 2020 *(miles/gallon)*										
Light Gas Vehicles	28.5	30.2	34.9	4.7	28.4	32.8	4.3	28.5	32.8	4.4
Medium Gas Vehicles	28.4	30.2	34.9	4.7	28.4	32.7	4.3	28.4	32.8	4.4
Heavy Gas Vehicles	20.4	20.6	24.2	3.6	20.5	24.0	3.6	20.4	24.0	3.6
Heavy Diesel Vehicles	20.3	20.4	24.0	3.6	20.3	23.9	3.6	20.3	23.9	3.5
Vehicle efficiency represents a fleet-wide average, not the average for new vehicles.										

Table B-26: Sensitivity Cases Fuel Price Results: Eight WCI Partners

Prices in 2020 (2007 $/mmBtu)	High Energy Prices & Generation Costs		Low Energy Prices		High Natural Gas Prices	
	Ref Price	Percent Diff	Ref Price	Percent Diff	Ref Price	Percent Diff
Residential						
Res Electricity Prices	37.5	-4%	29.0	10%	30.1	12%
Res Natural Gas Prices	22.8	6%	13.4	31%	14.5	68%
Res Oil Prices	40.0	4%	19.9	23%	25.5	6%
Res LPG Prices	21.7	4%	21.6	13%	21.6	5%
Commercial						
Com Electricity Prices	34.8	-4%	26.2	11%	27.3	11%
Com Natural Gas Prices	19.0	4%	9.4	23%	10.1	96%
Com Oil Prices	43.3	1%	22.5	7%	24.6	2%
Com LPG Prices	22.2	3%	21.6	8%	21.4	7%
Industrial						
Ind Electricity Prices	22.9	-2%	14.6	28%	15.4	28%
Ind Natural Gas Prices	16.4	2%	5.9	17%	6.3	169%
Ind Coal Prices	5.1	20%	2.1	148%	2.1	52%
Ind Oil Prices	35.0	3%	15.0	21%	20.7	4%
Ind LPG Prices	23.5	2%	23.2	6%	23.1	4%
Transportation						
Gasoline Prices	40.7	3%	20.7	21%	28.0	6%
Diesel Prices	40.6	3%	20.6	20%	27.7	5%

Table B-27: Sensitivity Cases Fuel Expenditure Results: Eight WCI Partners

Annual Fuel Expenditures in 2020 (M$/Yr)	**Original Reference Case**	**High Energy Prices & Generation Costs**			**Low Energy Prices**			**High Natural Gas Prices**		
		Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff	Ref Case	Cap-Trade Case	Diff
Sector										
Residential	45,609	59,685	51,704	(7,981)	43,546	40,351	(3,195)	45,609	49,857	4,247
Commercial	35,373	46,310	37,665	(8,646)	33,624	29,954	(3,670)	35,373	35,121	(252)
Energy Intensive Industry	32,725	45,447	40,833	(4,614)	28,528	25,567	(2,961)	32,725	34,487	1,762
Other Industry	18,496	26,917	24,680	(2,237)	15,624	14,919	(705)	18,496	19,811	1,315
Passenger Transportation	110,035	153,023	134,505	(18,518)	82,147	71,469	(10,677)	110,035	96,875	(13,160)
Freight Transportation	35,567	45,436	45,174	(262)	29,929	28,755	(1,174)	35,567	35,199	(369)
Agriculture	2,848	3,807	3,328	(478)	2,564	2,349	(216)	2,848	2,779	(69)
Total	**280,654**	380,625	337,889	(42,736)	235,962	213,364	(22,598)	280,654	274,129	(6,525)

Table B-28: Sensitivity Cases Potential Allowance Value: Eight WCI Partners

Allowance Value in 2020 (M$)	High Energy Prices & Generation Costs	Low Energy Prices	High Natural Gas Prices
	Diff from Reference	Diff from Reference	Diff from Reference
Sector			
Residential	$925	$3,064	$1,031
Commercial	$424	$1,456	$471
Energy Intensive Industry	$3,013	$9,705	$3,468
Other Industry	$443	$1,502	$510
Passenger Transportation	$4,325	$14,584	$5,150
Freight Transportation	$1,391	$5,332	$1,802
Agriculture	$0	$0	$0
Total	**10,521**	**35,642**	**12,434**
Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.			

Table B-29: Sensitivity Cases Cost Results: Eight WCI Partners

Annualized Costs in 2020 (M$/Yr)	High Energy Prices & Generation Costs	Low Energy Prices	High Natural Gas Prices
	Diff from Reference	Diff from Reference	Diff from Reference
Sector			
Residential	($9,724)	($3,749)	$4,833
Commercial	($12,158)	($4,120)	($1,394)
Energy Intensive Industry	$12,294	$11,335	$18,778
Other Industry	$1,917	$2,782	$5,806
Passenger Transportation	($21,999)	($20,845)	($19,589)
Freight Transportation	($298)	($1,362)	($423)
Agriculture	($546)	($287)	($131)
Total	**($30,514)**	**($16,245)**	**$7,880**
These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.			

Summary Results

Table B-30 presents summary results for the cases presented above. The GHG emissions are reported for the eight WCI partner jurisdictions included in the analysis. Fuel Expenditures and Total Costs (Savings) are relative to the appropriate Reference Case. The potential value of allowances is shown assuming that the full allowance value is passed through to consumers. Total Costs (Savings) include Fuel Expenditures and annualized investment costs. All emissions are in MMTCO2E and all costs are in 2007 dollars.

Table B-30: Summary Results for 2020: Eight WCI Partners

Case	GHG Emission (MMTCO2E)	Offsets Used (MMTCO2E)	Allowance Price (2007 $)	Change in Fuel Expenditures ($M/Yr)	Potential Allowance Value ($M/Yr)	Total Costs (Savings) ($M/Yr)
Reference Case	992.8	--	--	--	--	--
Cap-and-Trade Policy Cases						
Broad Scope, No Offsets	859.2	--	$63	(32,296)	39,516	(23,525)
Broad Scope, With Offsets	877.9	31.8	$24	(31,012)	15,150	(22,080)
Narrow Scope, With Offsets	847.8	18.2	$71	(22,794)	16,092	(11,422)
Sensitivity Cases						
High Price	833.3	12.7	$18	(42,736)	10,521	($30,514)
Low Price	857.0	34.1	$56	(22,598)	35,642	($16,245)
High Natural Gas Price	865.4	26.6	$20	(6,525)	12,434	$7,880

Fuel Expenditures and Total Costs (Savings) are changes from Reference Case values.
Potential Allowance Value calculated as emissions times allowance price.
Total Costs (Savings) do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.

Attachment 1: Banking

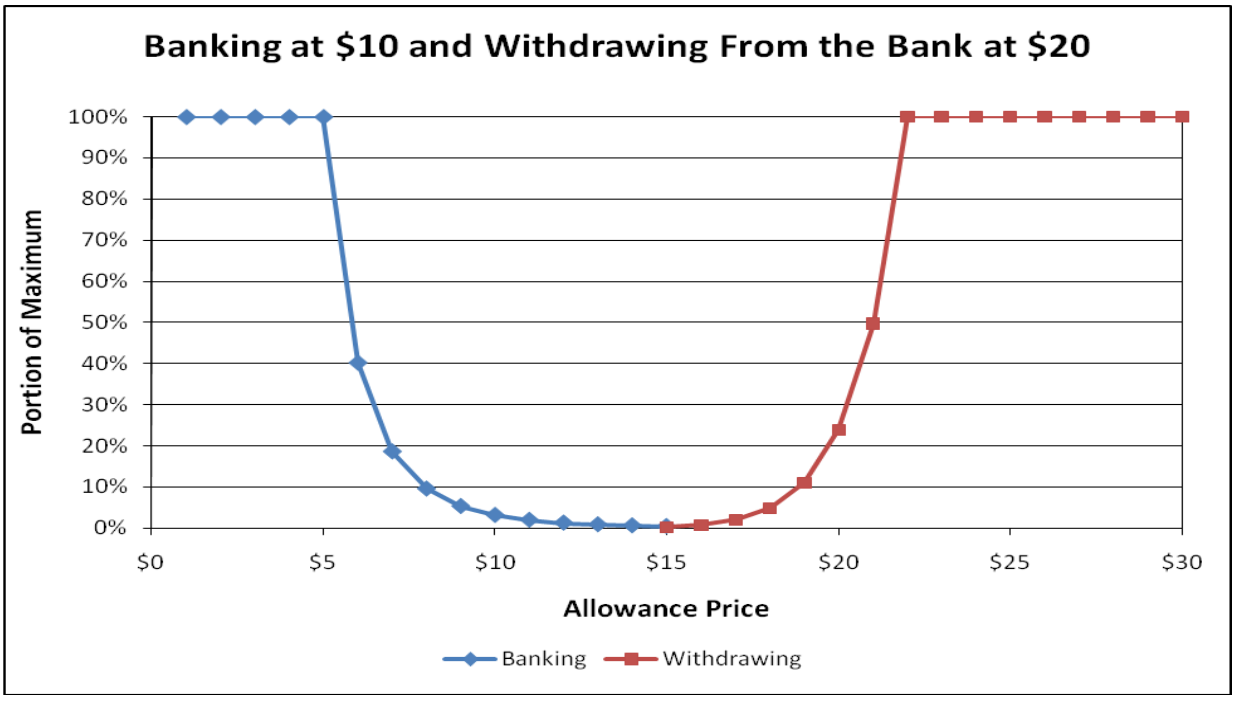
The purpose of banking is to enable allowances issued or auctioned in one year to be used in a later period. When allowance prices are low, allowances would likely be banked. When prices are high, allowances would be withdrawn from the bank. The model does not have the ability to optimize the banking behaviour in the market. Rather, banking is simulated using the following model input parameters:

- The price below which allowances are put into the bank.
- The maximum portion of emission allowances in a given year that can be banked.
- The price above which allowances are withdrawn from the bank.
- The maximum portion of the allowances in the bank in a given year that can be withdrawn.

Figure A-2 shows the banking and withdrawing curves used the cases presented here. The curves shown in the figure set the price below which allowances are banked at $10/ton. The price above which allowances are withdrawn from the bank is set at $20/ton.

The curves in the figure indicate the portion of the allowable banking and redeeming amounts that are simulated to be used. The recommended program design sets no limits on the amounts that can be banked. However, bounds are set in the model to better simulate behavior, particularly in the early years of the program when allowances prices are simulated to be low. The maximum amount put into the bank in a single year is limited to 10% of total allowances available in that year. The maximum amount withdrawn from the bank in a single year is limited to 30% of the allowances in the bank.

Figure B-2: Banking Curves



Attachment 2: Detailed Cap-and-Trade Policy Results

This attachment shows the detailed results for two of the cap-and-trade program model runs:

- Broad Scope, with complementary policies and with offsets; and
- Narrow Scope, with complementary policies and with offsets.

Cap-and-Trade Program: Broad Scope with Complementary Policies and Offsets

Table B-31: Cap-and-Trade Program Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners Broad Scope with Complementary Policies and Offsets

	2006	2010	2015	2020	Growth Rate 2006-2020
GHG Emissions *(MMTCO2E)*					
Residential	49.7	53.6	54.7	55.2	0.8%
Commercial	29.3	30.4	28.0	26.4	-0.8%
Energy Intensive Industry	176.8	174.0	172.2	175.0	-0.1%
Other Industry	29.8	30.2	28.5	27.0	-0.7%
Passenger Transport	290.8	291.7	276.5	259.0	-0.8%
Freight Transport	93.0	89.6	89.6	90.4	-0.2%
Power Sector	176.6	166.4	133.0	131.5	-2.1%
Waste & Wastewater	25.6	29.1	34.2	38.4	2.9%
Agriculture (non-energy)	59.9	62.1	67.5	74.9	1.6%
WCI Sub-Total	**931.6**	**927.1**	**884.1**	**877.9**	**-0.4%**
Compliance Summary					
Non-WCI Power Sector	70.0	70.0	70.0	70.0	
Non-WCI Power Sector Reductions	-	(0.1)	(20.3)	(37.0)	
Offsets	-	-	-	(31.8)	
Bank Flow	0.0	0.0	21.2	-31.8	
Compliance Total	**1,001.6**	**997.0**	**955.0**	**847.2**	
Percent of 2006 Emissions	*100.0%*	*99.5%*	*95.3%*	*84.6%*	
Bank Inventory	0.0	0.0	107.4	74.4	
Allowance Price (2007 $/MT)	**$0**	**$0**	**$6**	**$24**	
Percentage of Offsets Allowed	5%	5%	5%	5%	
Percent Allowable Offsets Used			**0%**	**100%**	
All emissions in million metric tons.					

Table B-32: Cap-and-Trade Program Energy Use: Eight WCI Partners
Broad Scope with Complementary Policies and Offsets

Total Energy Use *(TBtu/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Aviation Fuel	609	637	682	720	1.2%
Biomass	443	427	440	448	0.1%
Coal	1,185	1,212	1,063	1,043	-0.9%
Diesel	1,091	1,048	1,021	1,001	-0.6%
Ethanol	85	165	298	420	12.1%
Landfill Gas	29	29	29	29	0.2%
LPG	231	239	242	249	0.5%
Gasoline	3,303	3,219	2,920	2,628	-1.6%
Natural Gas	3,947	3,764	3,217	3,075	-1.8%
Nuclear	658	658	658	658	0.0%
Oil, Unspecified	695	687	679	688	-0.1%
Other	2,902	2,944	2,892	2,952	0.1%
Total	**15,178**	**15,031**	**14,139**	**13,911**	**-0.6%**
Total Energy Use *(TBtu/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	1,638	1,769	1,813	1,856	0.9%
Commercial	1,357	1,385	1,291	1,260	-0.5%
Energy Intensive Industry	2,508	2,374	2,151	2,035	-1.5%
Other Industry	1,015	1,031	1,011	1,003	-0.1%
Agriculture	140	127	107	94	-2.8%
Passenger Transportation	3,998	4,025	3,870	3,702	-0.5%
Freight Transportation	1,219	1,183	1,204	1,235	0.1%
Waste & Wastewater	-	-	-	-	#N/A
Power Sector	3,302	3,137	2,693	2,727	-1.4%
Total	**15,178**	**15,031**	**14,139**	**13,911**	**-0.6%**

Table B-33: Cap-and-Trade Program Electric Sector Results: Eight WCI Partners Broad Scope with Complementary Policies and Offsets

Generation Capacity *(MW)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Gas/Oil	62,973	72,139	96,879	109,919	4.1%
Coal	14,972	15,372	15,372	15,372	0.2%
Nuclear	9,330	9,330	9,330	9,330	0.0%
Hydro	61,721	63,374	63,444	63,471	0.2%
Landfill Gas/EFW	338	347	347	347	0.2%
Wind	4,083	6,827	17,979	22,945	13.1%
Other	4,358	4,537	5,618	6,354	2.7%
Total	**157,776**	**171,925**	**208,969**	**227,738**	**2.7%**
Generation Output *(GWh/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Gas/Oil	143,907	130,007	97,216	101,382	-2.5%
Coal	99,280	100,365	86,458	85,318	-1.1%
Nuclear	65,072	65,072	65,072	65,072	0.0%
Hydro	256,243	267,713	268,207	268,398	0.3%
Landfill Gas/EFW	2,036	2,088	2,088	2,088	0.2%
Wind	8,733	16,245	47,160	60,925	14.9%
Other	23,554	24,606	30,894	34,579	2.8%
Total	**598,824**	**606,095**	**597,095**	**617,761**	**0.2%**
Sales (GWh/year)	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	202,826	218,393	223,899	232,447	1.0%
Commercial	231,140	233,974	220,827	222,998	-0.3%
Industrial	163,747	161,191	155,272	162,071	-0.1%
Transportation	4,864	6,663	7,729	8,229	3.8%
Street Lights/Misc.	16,447	16,447	16,447	16,447	0.0%
Resale	-	-	-	-	#N/A
Total Sales	**619,023**	**636,669**	**624,174**	**642,191**	**0.3%**

Table B-34: Cap-and-Trade Program Transportation Sector Results: Eight WCI Partners Broad Scope with Complementary Policies and Offsets

Distance Travelled (millions of vehicle miles travelled)					
	2006	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Passenger	556,055	585,955	631,048	672,665	1.4%
Freight	72,562	73,248	77,307	81,715	0.9%
Passenger: Miles/person	8,755	8,724	8,779	8,765	0.0%
Vehicle Efficiency (miles/gallon)					
	2006	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Light Gas Vehicles	23.2	24.6	28.3	32.8	2.5%
Medium Gas Vehicles	23.2	24.6	28.2	32.8	2.5%
Heavy Gas Vehicles	16.9	17.8	20.8	24.0	2.5%
Heavy Diesel Vehicles	16.9	17.8	20.8	23.9	2.5%
Vehicle efficiency represents a fleet-wide average, not the average for new vehicles.					

Table B-35: Cap-and-Trade Program Fuel Prices: Eight WCI Partners Broad Scope with Complementary Policies and Offsets

Prices (2007 $/mmBtu)	**2006**	**2010**	**2015**	**2020**
Residential				
Res Electricity Prices	29.4	30.9	29.7	30.4
Res Natural Gas Prices	11.5	13.5	14.4	16.3
Res Oil Prices	21.0	23.3	24.5	27.5
Res LPG Prices	22.7	24.2	22.0	22.8
Commercial				
Com Electricity Prices	26.4	27.8	26.5	27.2
Com Natural Gas Prices	8.8	10.0	10.0	10.9
Com Oil Prices	23.1	25.0	24.2	25.1
Com LPG Prices	22.5	24.3	22.0	22.3
Industrial				
Ind Electricity Prices	16.3	17.1	15.6	16.4
Ind Natural Gas Prices	6.7	7.4	6.6	6.7
Ind Coal Prices	2.2	2.2	2.5	3.5
Ind Oil Prices	16.4	18.4	19.6	22.0
Ind LPG Prices	23.9	25.5	23.3	23.8
Transportation				
Gasoline Prices	21.9	24.1	26.5	29.8
Diesel Prices	21.8	24.0	26.3	29.5

Table B-36: Cap-and-Trade Program Fuel Expenditures: Eight WCI Partners Broad Scope with Complementary Policies and Offsets

Annual Fuel Expenditures (M$/Yr)					
Sector	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	31,763	37,464	38,001	40,244	1.7%
Commercial	28,452	31,263	28,475	29,356	0.2%
Energy Intensive Industry	28,969	31,127	28,693	29,119	0.0%
Other Industry	14,567	16,483	16,156	17,062	1.1%
Passenger Transportation	82,031	91,324	93,969	96,251	1.1%
Freight Transportation	28,315	30,055	32,173	35,111	1.5%
Agriculture	3,140	3,140	2,625	2,499	-1.6%
Total	**217,237**	**240,856**	**240,093**	**249,641**	**1.0%**

Table B-37: Cap-and-Trade Program Potential Allowance Value: Eight WCI Partners Broad Scope with Complementary Policies and Offsets

Allowance Value (M$)				
Sector	**2006**	**2010**	**2015**	**2020**
Residential	$0	$0	$355	$1,321
Commercial	$0	$0	$182	$631
Energy Intensive Industry	$0	$0	$1,118	$4,188
Other Industry	$0	$0	$185	$647
Passenger Transportation	$0	$0	$1,794	$6,199
Freight Transportation	$0	$0	$581	$2,164
Agriculture	$0	$0	$0	$0
Total	**$0**	**$0**	**$4,215**	**$15,150**

Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.

Table B-38: Cap-and-Trade Program Annualized Costs (Savings): Eight WCI Partners Broad Scope with Complementary Policies and Offsets

Annualized Cost (M$/Yr) (Change from Reference Case)				
Sector	**2006**	**2010**	**2015**	**2020**
Residential	$0	$331	($2,279)	($6,158)
Commercial	$0	($37)	($3,632)	($7,369)
Energy Intensive Industry	$0	$1,109	$4,981	$10,908
Other Industry	$0	$258	$858	$1,996
Passenger Transportation	$0	($5,326)	($15,388)	($20,511)
Freight Transportation	$0	($0)	($119)	($522)
Agriculture	$0	($3)	($231)	($425)
Total	**$0**	**($3,668)**	**($15,810)**	**($22,080)**
These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.				

Cap-and-Trade Program: Narrow Scope with Complementary Policies and Offsets

Table B-39: Cap-and-Trade Program Greenhouse Gas Emissions and Compliance Summary: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

GHG Emissions *(MMTCO2E)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	49.7	53.6	54.8	55.9	0.9%
Commercial	29.3	30.4	28.1	27.0	-0.6%
Energy Intensive Industry	176.8	174.0	171.4	172.6	-0.2%
Other Industry	29.8	30.2	28.3	26.3	-0.9%
Passenger Transport	290.8	291.7	276.8	259.9	-0.8%
Freight Transport	93.0	89.6	89.9	91.7	-0.1%
Power Sector	176.6	166.4	132.4	104.8	-3.7%
Waste & Wastewater	25.6	29.1	34.2	38.4	2.9%
Agriculture (non-energy)	59.9	62.1	64.5	71.1	1.2%
WCI Sub-Total	**931.6**	**927.1**	**880.4**	**847.8**	**-0.7%**
Compliance Summary					
Non-WCI Power Sector Reductions	-	-	(21.3)	(45.0)	
Offsets	-	-	(11.7)	(18.2)	
Bank Flow	0.0	0.0	0.0	-0.2	
Compliance Total	**1,001.6**	**997.1**	**917.4**	**854.3**	
Percent of 2006 Emissions	*100.0%*	*99.5%*	*91.6%*	*85.3%*	
Bank Inventory	0.0	0.0	2.7	0.5	
Allowance Price (2007 $/MT)	**$0**	**$0**	**$19**	**$71**	
Percentage of Offsets Allowed	5%	5%	5%	5%	
Percent of Allowable Offsets Used			**57%**	**100%**	

Table B-40: Cap-and-Trade Program Energy Use: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

Total Energy Use *(TBtu/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Aviation Fuel	609	637	683	725	1.3%
Biomass	443	427	441	452	0.1%
Coal	1,185	1,212	1,054	618	-4.5%
Diesel	1,091	1,048	1,024	1,014	-0.5%
Ethanol	85	165	298	419	12.1%
Landfill Gas	29	29	29	29	0.2%
LPG	231	239	242	250	0.5%
Gasoline	3,303	3,219	2,923	2,635	-1.6%
Natural Gas	3,947	3,764	3,210	3,296	-1.3%
Nuclear	658	658	658	658	0.0%
Oil, Unspecified	695	687	678	687	-0.1%
Other	2,902	2,944	2,889	2,934	0.1%
Total	**15,178**	**15,031**	**14,129**	**13,718**	**-0.7%**
Total Energy Use *(TBtu/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	1,638	1,769	1,815	1,863	0.9%
Commercial	1,357	1,385	1,292	1,265	-0.5%
Energy Intensive Industry	2,508	2,374	2,141	2,005	-1.6%
Other Industry	1,015	1,031	1,008	991	-0.2%
Agriculture	140	127	107	92	-2.9%
Passenger Transportation	3,998	4,025	3,873	3,712	-0.5%
Freight Transportation	1,219	1,183	1,208	1,251	0.2%
Waste & Wastewater	-	-	-	-	#N/A
Power Sector	3,302	3,137	2,685	2,539	-1.9%
Total	**15,178**	**15,031**	**14,129**	**13,718**	**-0.7%**

Table B-41: Cap-and-Trade Program Electric Sector Results: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

Generation Capacity *(MW)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Gas/Oil	62,973	72,139	96,879	109,879	4.1%
Coal	14,972	15,372	15,372	15,372	0.2%
Nuclear	9,330	9,330	9,330	9,330	0.0%
Hydro	61,721	63,374	63,444	63,462	0.2%
Landfill Gas/EFW	338	347	347	347	0.2%
Wind	4,083	6,827	17,979	22,721	13.0%
Other	4,358	4,537	5,618	6,344	2.7%
Total	**157,776**	**171,925**	**208,969**	**227,456**	**2.6%**
Generation Output *(GWh/year)*	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Gas/Oil	143,907	130,007	97,031	134,044	-0.5%
Coal	99,280	100,365	86,172	46,848	-5.2%
Nuclear	65,072	65,072	65,072	65,072	0.0%
Hydro	256,243	267,713	268,207	268,337	0.3%
Landfill Gas/EFW	2,036	2,088	2,088	2,088	0.2%
Wind	8,733	16,245	47,160	60,305	14.8%
Other	23,554	24,606	30,926	34,558	2.8%
Total	**598,824**	**606,095**	**596,656**	**611,251**	**0.1%**
Sales (GWh/year)	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	202,826	218,393	223,631	230,725	0.9%
Commercial	231,140	233,974	220,504	221,170	-0.3%
Industrial	163,747	161,191	155,498	162,118	-0.1%
Transportation	4,864	6,663	7,691	7,923	3.5%
Street Lights/Misc.	16,447	16,447	16,447	16,447	0.0%
Resale	-	-	-	-	#N/A
Total Sales	**619,023**	**636,669**	**623,771**	**638,383**	**0.2%**

Table B-42: Cap-and-Trade Program Transportation Sector Results: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

Distance Travelled *(millions of vehicle miles travelled)*					
	2006	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Passenger	556,055	585,955	631,324	673,720	1.4%
Freight	72,562	73,248	77,423	82,189	0.9%
Passenger: Miles/person	8,755	8,724	8,782	8,778	0.0%
Vehicle Efficiency *(miles/gallon)*					
	2006	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Light Gas Vehicles	23.2	24.6	28.2	32.8	2.5%
Medium Gas Vehicles	23.2	24.6	28.2	32.8	2.5%
Heavy Gas Vehicles	16.9	17.8	20.8	24.0	2.5%
Heavy Diesel Vehicles	16.9	17.8	20.8	23.9	2.5%
Vehicle efficiency represents a fleet-wide average, not the average for new vehicles.					

Table B-43: Cap-and-Trade Program Fuel Prices: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

Prices (2007 $/mmBtu)	**2006**	**2010**	**2015**	**2020**
Residential				
Res Electricity Prices	29.4	30.9	30.4	33.9
Res Natural Gas Prices	11.5	13.5	14.0	14.6
Res Oil Prices	21.0	23.3	24.0	25.5
Res LPG Prices	22.7	24.2	21.7	21.6
Commercial				
Com Electricity Prices	26.4	27.8	27.2	31.2
Com Natural Gas Prices	8.8	10.0	9.8	10.0
Com Oil Prices	23.1	25.0	24.0	24.7
Com LPG Prices	22.5	24.3	21.8	21.7
Industrial				
Ind Electricity Prices	16.3	17.1	16.3	20.8
Ind Natural Gas Prices	6.7	7.4	6.8	7.5
Ind Coal Prices	2.2	2.2	3.3	6.0
Ind Oil Prices	16.4	18.4	20.3	24.7
Ind LPG Prices	23.9	25.5	23.6	24.7
Transportation				
Gasoline Prices	21.9	24.1	26.0	28.0
Diesel Prices	21.8	24.0	25.8	27.7

Table B-44: Cap-and-Trade Program Fuel Expenditures: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

Annual Fuel Expenditures (M$/Yr)					
Sector	**2006**	**2010**	**2015**	**2020**	**Growth Rate 2006-2020**
Residential	31,763	37,464	38,520	43,138	2.2%
Commercial	28,452	31,263	28,989	32,098	0.9%
Energy Intensive Industry	28,969	31,127	28,806	29,831	0.2%
Other Industry	14,567	16,483	16,327	17,977	1.5%
Passenger Transportation	82,031	91,324	94,072	96,577	1.2%
Freight Transportation	28,315	30,055	32,280	35,568	1.6%
Agriculture	3,140	3,140	2,661	2,669	-1.2%
Total	217,237	240,856	241,656	257,859	1.2%

Table B-45: Cap-and-Trade Program Potential Allowance Value: Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

Allowance Value (M$)				
Sector	**2006**	**2010**	**2015**	**2020**
Residential	$0	$0	$0	$0
Commercial	$0	$0	$521	$1,925
Energy Intensive Industry	$0	$0	$3,176	$12,293
Other Industry	$0	$0	$524	$1,873
Passenger Transportation	$0	$0	$0	$0
Freight Transportation	$0	$0	$0	$0
Agriculture	$0	$0	$0	$0
Total	**$0**	**$0**	**$4,221**	**16,092**

Potential allowance value is calculated as the allowance price times the emissions in the sector. The full allowance value may not be incurred in each sector depending on the manner in which allowances are distributed and the ability to pass allowance costs to customers.

Table B-46: Cap-and-Trade Program Annualized Costs (Savings): Eight WCI Partners Narrow Scope with Complementary Policies and Offsets

Annualized Cost (M$/Yr) (Change from Reference Case)				
Sector	**2006**	**2010**	**2015**	**2020**
Residential	$0	$331	($1,771)	($3,327)
Commercial	$0	($37)	($3,144)	($4,760)
Energy Intensive Industry	$0	$1,109	$5,237	$12,674
Other Industry	$0	$258	$1,085	$3,250
Passenger Transportation	$0	($5,326)	($15,073)	($19,005)
Freight Transportation	$0	($0)	$0	$0
Agriculture	$0	($3)	($194)	($254)
Total	**$0**	**($3,668)**	**($13,859)**	**($11,422)**
These costs do not include costs of VMT Reduction programs, Energy Efficiency programs, nor Potential Allowance Value.				